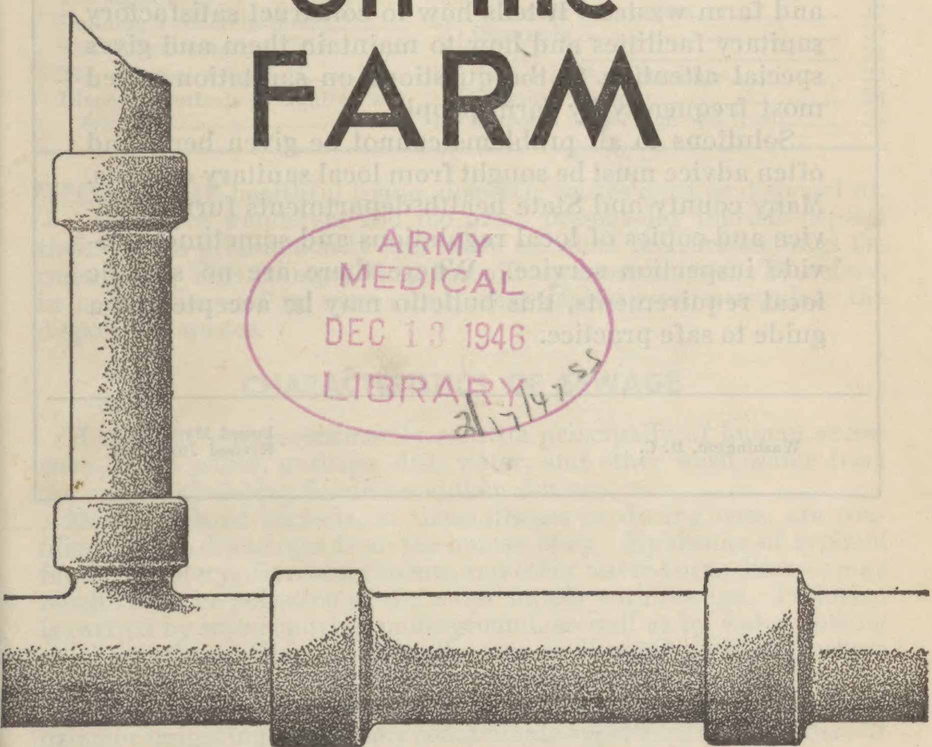
[Rockey, John Wesley]

no. 8

SEWAGE and GARBAGE DISPOSAL on the FARM



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U.S. DEPARTMENT OF AGRICULTURE

THIS Bulletin is a guide to up to-date methods for the sanitary disposal of sewage and other household and farm wastes. It tells how to construct satisfactory sanitary facilities and how to maintain them and gives special attention to the questions on sanitation asked most frequently by farm people.

Solutions to all problems cannot be given here, and often advice must be sought from local sanitary officials. Many county and State health departments furnish advice and copies of local regulations and sometimes provide inspection service. Where there are no specific local requirements, this bulletin may be accepted as a guide to safe practice.

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SEWAGE AND GARBAGE DISPOSAL ON THE FARM

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Contents

TO INSURE healthful living, domestic wastes must be disposed of. Primitive wanderers and too often present-day tourists deposit their wastes promiscuously and move on when the surroundings become foul. This is impractical in built-up communities. Therefore, in most cities and in some rural areas sanitary codes regulate the disposal of wastes.

CHARACTERISTICS OF SEWAGE

Household sewage ordinarily consists principally of human excrement, toilet paper, garbage, dish water, and other wash water from the various plumbing fixtures and floor drains.

Many kinds of bacteria, at times disease-producing ones, are contained in the discharges from the human body. Epidemics of typhoid fever, dysentery, diarrhea, cholera, and other water-borne diseases may result from the pollution of the water supply with sewage. Pollution is carried by water moving underground, as well as by water flowing on the surface. This is especially true in limestone regions, where underground channels and rock crevices permit water to flow for considerable distances with little filtering action. Sewage used for fertilizing or irrigating crops [2] may contaminate vegetables or the udders of cows and thus spread disease. Anthrax, cholera, and parasitic worms may be present in the surface drainage from fields and barn lots. It is

[1] The senior author prepared the preliminary draft, and the junior author completed the bulletin.

[2] This subject is discussed at length in Technical Bulletin 675, Sewage Irrigation as Practiced in the Western States.

wise to regard all sewage as dangerous and to dispose of it promptly in a sanitary manner, so that disease germs will not pollute the water supplies or be spread by flies, animals, or man.

PROTECTION OF WATER SOURCES FROM HOUSEHOLD WASTES

Under most farm conditions a safe place for the disposal of wastes is in the upper 3-foot layer of soil, where the action of bacteria tends to render it harmless. Tile disposal fields, such as are used with septic tanks, and earth-pit privies accomplish this if the water table remains several feet below the surface and if the location is remote from water supplies. Cesspools and other types of pits do not ordinarily confine contamination to their immediate vicinity and are not recommended except for special conditions.

Sewage or other wastes discharged into abandoned wells or other pits that reach to the water table or below it are almost certain to contaminate the ground water.

It is generally poor practice, and often illegal, to discharge wastes into surface streams. Streams do not necessarily purify themselves in 50 feet, 100 feet, or some other stated distance, as is commonly believed. They do tend to purify themselves over long distances through the action of sunlight, aeration, and other factors but may not be safe for domestic use for many miles below the source of pollution. Clear, sparkling water is not always safe drinking water. Streams in agricultural communities are subject to many sources of pollution and they are likely to become more contaminated as they merge into larger streams.

SEPTIC-TANK SYSTEMS

Septic-tank systems, if installed and maintained properly, provide the most sanitary method of sewage disposal for farmhouses equipped with running water.

Ground water or rock close to the surface, lack of sufficient fall for the sewage to flow by gravity, and too small an absorption area for the effluent limit the satisfactory operation of a septic tank. When these conditions exist, special advice should be sought from a competent local sanitary authority. Adverse soil conditions can be overcome if sufficient fall and space are available.

The five essential parts (fig. 1) of a septic-tank system are (1) the house sewer; (2) the septic tank; (3) the effluent sewer; (4) the distribution box; and (5) the disposal field. In special cases a grease trap (see fig. 11, p. 19) is added. To facilitate inspection and repairs it is good practice to keep in the house a chart showing the location of the tank and other parts of the system.

A septic tank does not necessarily purify the sewage, eliminate odor, or destroy all solid matter. Its purpose is to condition the sewage or domestic waste by bacterial action, so that it can be disposed of in a more satisfactory manner.

OPERATION OF A SEPTIC-TANK SYSTEM

In a septic-tank system the sewage flows by gravity from the farmhouse through the sewer into the tank, where it should remain at

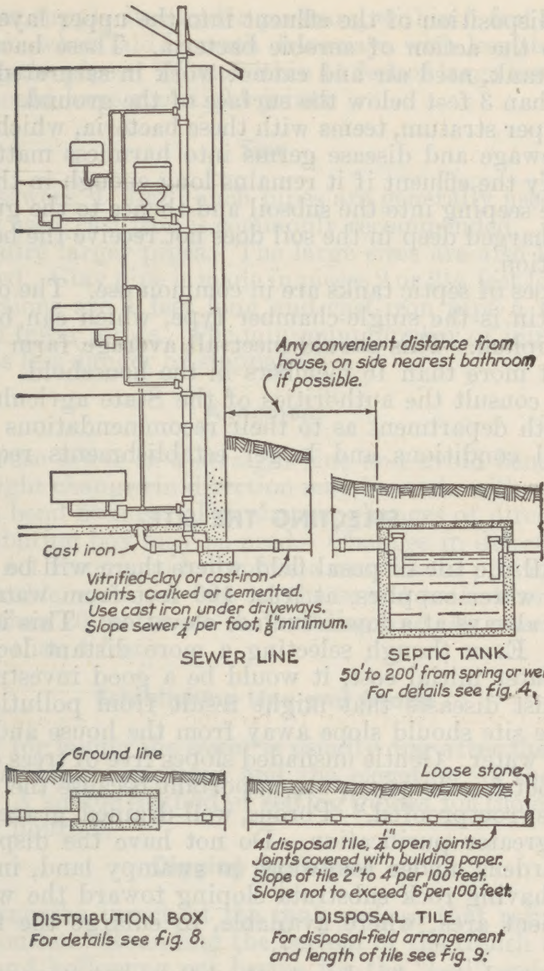


FIGURE 1.—A septic-tank system.

least 24 hours. While passing through the tank the solids are acted upon by anaerobic bacteria, which work only in the dark and where there is little air. The heavy particles settle to the bottom as sludge, the lighter particles float as scum, and the remainder passes out of the tank through the effluent sewer to the disposal field. The gas released in the process escapes through a vent provided either in the T to the house sewer or the effluent sewer.

A tank that is too small may fill up with solids in a short while, because sufficient time is not allowed for breaking them down by fermentation, or the sewage may be pushed right through into the disposal field and clog it.

The effluent may contain even more disease germs than the original sewage, and though it may be as clear as spring water it is far from pure and may cause foul odors if discharged or allowed to pool on the surface of the ground.

The final disposition of the effluent into the upper layer of the soil exposes it to the action of aerobic bacteria. These bacteria, unlike those in the tank, need air and cannot work in saturated soil or live much more than 3 feet below the surface of the ground. The "living earth," or upper stratum, teems with these bacteria, which convert the dangerous sewage and disease germs into harmless matter and thus tend to purify the effluent if it remains long enough in the top layers of soil before seeping into the subsoil and thence to the ground water. Effluent discharged deep in the soil does not receive the benefit of this purifying action.

Several types of septic tanks are in common use. The one described in this bulletin is the single-chamber type, which can be built with or without siphon. This should meet all average farm needs where there are not more than 16 members in the household. It would be advisable to consult the authorities of the State agricultural college or local health department as to their recommendations because frequently local conditions and larger establishments require special installations.

SELECTING THE SITE

First install the tile disposal field where there will be least danger of polluting water supplies, at least 100 feet from water sources if possible and always at a lower surface elevation. This is of greatest importance. Even though selecting a more distant location would result in greater initial cost, it would be a good investment as protection against diseases that might result from pollution of water sources. The site should slope away from the house and away from the source of water. Gentle unshaded slopes free of trees or shrubbery are best. Root-free locations are important because the open-jointed tile cannot be "rootproofed." Porous, well-drained, gravelly, or sandy soil allows greater purification. Do not have the disposal field in vegetable gardens, under roadways, in swampy land, in muck soils, or in areas having rock substrata sloping toward the water supply. Allow sufficient area, where available, to enlarge the field later if needed.

The septic tank may be close to the house, but a more distant site would reduce the likelihood of odors if leakage occurs. The tank should also be kept 50 feet or more from any source of water supply and at a lower elevation. It should not be placed under driveways, pavements, or flower beds, as these would make it not readily accessible for periodic inspection. Care should be taken to insure that surface drainage from the area around the tank will not reach the vicinity of the water supply.

THE HOUSE SEWER

Material

Vitrified salt-glazed clay or well-made concrete sewer pipe and cast-iron soil pipe are the standard materials for house sewers on farms. Asphalt-impregnated fiber pipe, of a type designed especially for house sewers, appears to be satisfactory for this purpose. Cast-iron soil pipe with leaded joints should be used when the sewer is within 50 feet of a well or suction line from a well, within 10 feet of any

drinking-water supply line under pressure, within 5 feet of basement foundations, or when laid beneath driveways with less than 3 feet of earth covering the pipes. When within 15 feet of large trees or shrubs, the sewers should have root-tight joints.

Size

For house sewers, 4- and 6-inch pipes are generally used. Where a 4-inch pipe is used, cast iron is commonly recommended. Grades with little fall require larger pipes. The large sizes are also less liable to become clogged. Clay pipe is made in pieces 2 or 2½ feet long, whereas fiber-pipe sections are 4 feet long and cast-iron pipe 5 feet long, so that there are fewer joints. The minimum number of joints is desirable, as there is less danger of stoppage.

Alinement

Run the house sewer in a straight line and avoid bends whenever possible. Slight changes in direction may be made with one-sixteenth or one-eighth bend fittings. For sharper changes of direction a manhole or distribution box may be used. Changes in direction of more than 45° are not recommended unless a manhole is provided. Cleanouts are desirable within 5 feet of the septic tank where tanks are placed more than 20 feet from the building and the sewer line is not buried deeper than 4 feet.

Establishing Line and Grade

The trench for laying the sewer is usually dug after the septic-tank excavation has been completed and the elevation of the tank inlet determined. A simple method of setting guides for the excavation is illustrated in figure 2.

Digging the Trench

Start digging the trench at the tank end, so that rain or seepage will have an outlet. Rounding the bottom of the trench to the shape of the pipe and hollowing out basins for the "bell" ends allows the pipe to rest firmly throughout its full length, permits full calking of joints, and relieves the strain on them.

Laying the Pipe

Begin laying the pipe at the tank with the bell end uphill. Joints in clay-tile pipe are commonly made with portland cement mortar or grout. Where rootproof joints are essential, sulfur-sand compounds may be used or copper rings provided and used with cement-mortar joints. Asphalt-mastic compounds, however, are more satisfactory. For cast-iron soil pipe, lead is the standard joint material.

After the hub is pushed into the bell, oakum (or old hemp rope) is packed with a calking iron or a piece of wood (fig. 3, *A*) solidly and evenly in the joint to a depth of about half an inch to center the hub end in the bell and to keep the joint filler from getting inside the pipe. Oil, grease, or dirt on the joint surfaces should be removed, as it will prevent joint material from sticking. Figure 3 shows the different jointing methods.

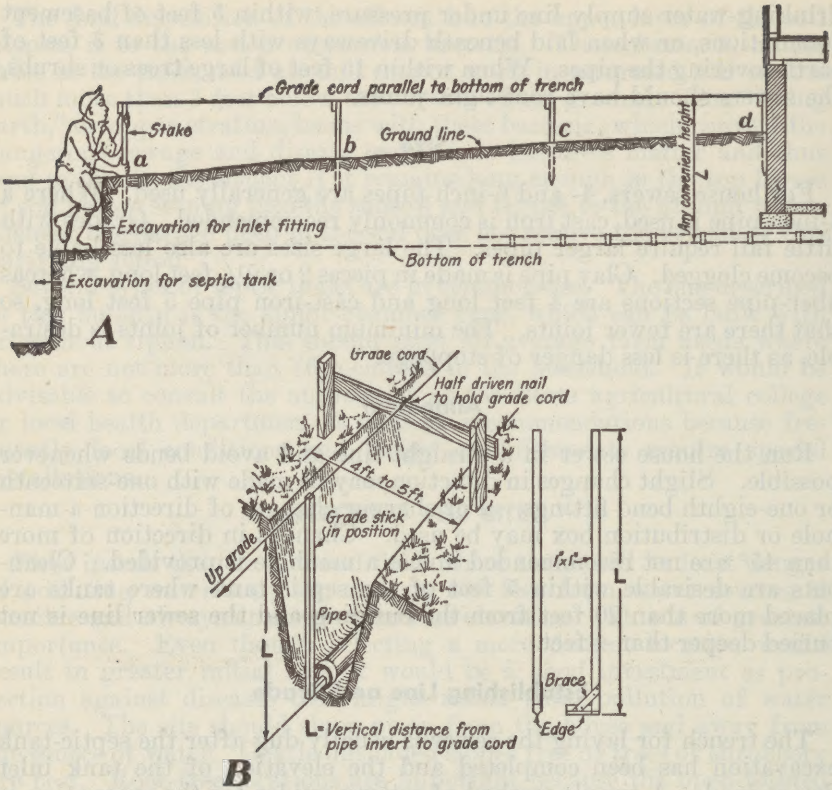


FIGURE 2.—Establishing grade for sewer. *A*, 2- by 4-inch stakes are set each side of the trench at convenient distances *a*, *b*, *c*, and *d*. Then a board is nailed horizontally on the stakes at *d* at a convenient height above the bottom of the trench, that is, the bottom of the sewer leaving the house. A board is nailed likewise to the stakes at *a* the same height above the inlet to the tank that *d* is above the bottom of the trench. Similarly, boards are set at *b* and *c* by sighting from *a* to *d* so the tops of the intermediate boards will be in line. *B*, The exact grade of the sewer is obtained by measuring from the grade cord with the 1- by 1-inch stick, shown in detail. The length of the stick must equal the height of the board above sewer at *d*.

Bituminous, sulfur-sand, lead, and other commercial joint compounds are poured while hot into the joint from a ladle (fig. 3, *F*), and when the work is well done they form a joint that is practically rootproof. They are more expensive than cement mortar.

For molding hot compounds, a clay dike, or funnel, built about 3 inches high around the triangular opening at the top of the jointer greatly aids in the rapid and complete filling of the joint space. A hot joint must be poured continuously, otherwise a seam may develop between successive pourings.

Bituminous compounds make a slightly elastic joint. A joint in 4-inch pipe requires about 3/8 to 1/2 pound of compound and in 6-inch pipe about 1 to 1 1/2 pounds.

Sulfur-sand joints are hard and inelastic. The compound is made by mixing together equal volumes of ordinary powdered sulfur and very fine clean sand, preferably the finest quicksand, and then heating

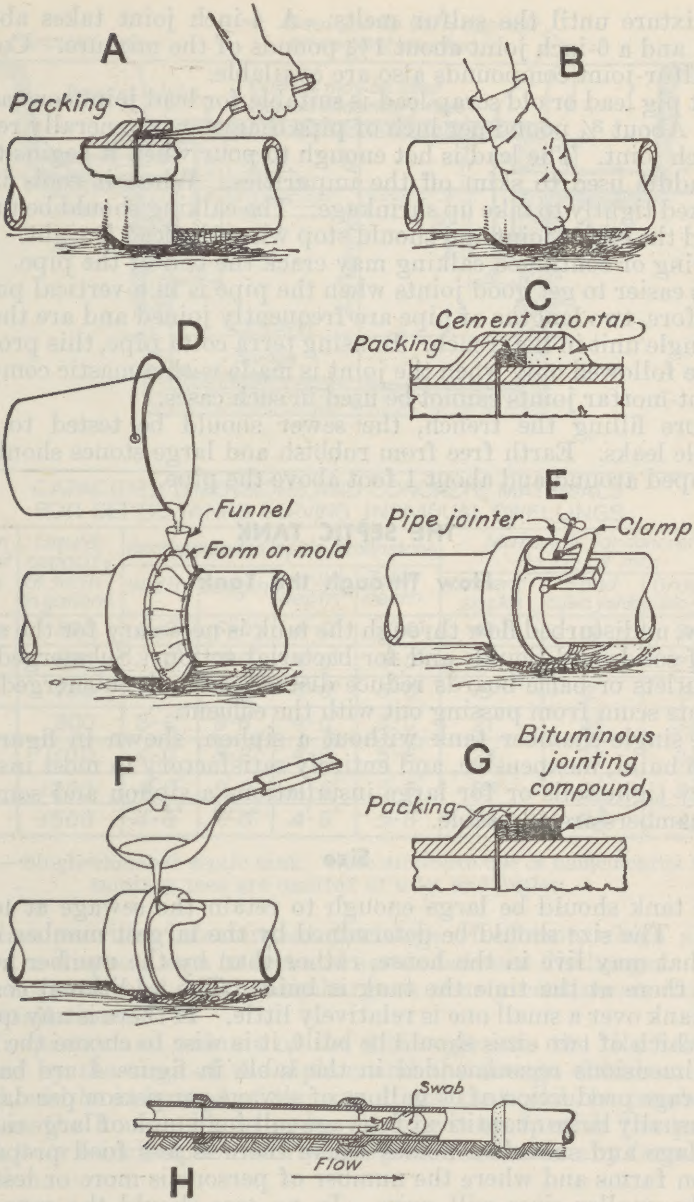


FIGURE 3.—Jointing sewer pipe. *A*, Using calking iron to force packing into joint. *B*, Making joint with 1 : 2 portland cement mortar. Use only enough water to dampen the mix. Recalk after half an hour, to close shrinkage cracks. *C*, The completed joint. Wrap finished joint with cloth and keep dampened, to aid curing. *D*, Joint made by pouring 1 : 1 portland cement grout of creamy consistency into a form. This type of joint is not feasible unless the metal forms shown are available. *E*, Use of asbestos runner clamped around pipe, for pouring hot joint. *F*, Clay roll used in place of asbestos runner. *G*, A completed bituminous joint. *H*, Use of swab, to remove any joint material forced through to inside of pipe.

the mixture until the sulfur melts. A 4-inch joint takes about 3/4 pound and a 6-inch joint about 1 7/8 pounds of the mixture. Commercial sulfur-joint compounds also are available.

Soft pig lead or old scrap lead is suitable for lead joints on cast-iron pipe. About 3/4 pound per inch of pipe diameter is generally required for each joint. The lead is hot enough to pour when it begins to char the paddle used to skim off the impurities. When it cools it must be calked tightly to take up shrinkage. The calking should be uniform around the entire joint and should stop when the lead is tight. Heavy pounding or continued calking may crack the bell of the pipe.

It is easier to get good joints when the pipe is in a vertical position. Therefore, two lengths of pipe are frequently joined and are then laid as a single unit in the trench. In using terra cotta pipe, this procedure may be followed only when the joint is made with a mastic compound. Cement-mortar joints cannot be used in such cases.

Before filling the trench, the sewer should be tested to detect possible leaks. Earth free from rubbish and large stones should then be tamped around and about 1 foot above the pipe.

THE SEPTIC TANK

Flow Through the Tank

Slow, undisturbed flow through the tank is necessary for the separation of solids and liquids and for bacterial action. Submerged inlets and outlets or baffle boards reduce disturbance. A submerged outlet prevents scum from passing out with the effluent.

The single-chamber tank without a siphon, shown in figure 4, is easy to build, inexpensive, and entirely satisfactory in most instances. In very tight soils or for large installations a siphon and sometimes two chambers are advisable.

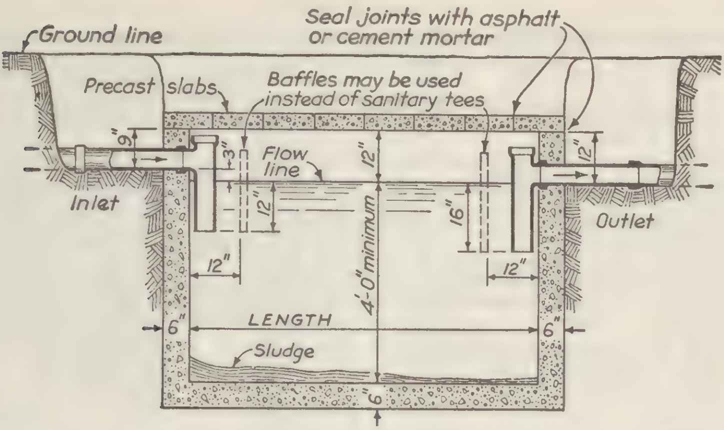
Size

The tank should be large enough to retain the sewage at least 24 hours. The size should be determined by the largest number of persons that may live in the house, rather than by the number actually living there at the time the tank is built. The additional cost of a large tank over a small one is relatively little. If there is any question as to which of two sizes should be built, it is wise to choose the larger. The dimensions recommended in the table in figure 4 are based on an average production of 50 gallons of sewage per person per day.

Unusually large quantities of sewage call for a tank of large capacity. In village and suburban homes where there is less food preparation than on farms and where the number of persons is more or less fixed, slightly smaller sizes will serve. In no case should the capacity of the tank below the flow line be less than 500 gallons. A tank length of two to three times the width should be maintained, and it is advisable to provide a depth of at least 4 feet below the flow line.

Allow about 1 foot of "freeboard," or air space, above the flow line for the accumulation of gases. This space is generally vented through the soil stack of the house.

A siphon (fig. 5) with a dosing chamber is not considered necessary for a farm septic tank except for large installations (1,000 gallons or more), for those in tight soils, and where the disposal field is limited.



CAPACITIES, DIMENSIONS, AND CONCRETE MATERIALS FOR SEPTIC TANKS SERVING INDIVIDUAL DWELLINGS								
Maximum number of persons served	Liquid capacity of tank in gallons	Recommended inside dimensions				Materials for concrete 1 : 2½ : 4 mix		
		Width	Length	Liquid depth	Total depth	Cement sacks	Sand cubic yards	Gravel cubic yards
4 or less	500	3'-0"	6'-0"	4'-0"	5'-0"	16	1½	2½
6	600	3'-0"	7'-0"	4'-0"	5'-0"	17	1¾	2¾
8	750	3'-6"	7'-6"	4'-0"	5'-0"	19	2	3
10	900	3'-6"	8'-6"	4'-0"	5'-0"	21	2¼	3¼
12	1100	4'-0"	8'-6"	4'-6"	5'-6"	24	2¼	3½
14	1200	4'-0"	9'-0"	4'-6"	5'-6"	25	2½	3¾
16	1500	4'-6"	10'-0"	4'-6"	5'-6"	28	2¾	4¼

FIGURE 4.—Single-chamber septic tank. Note alternate use of baffle boards where sanitary tees are omitted at inlet and outlet.

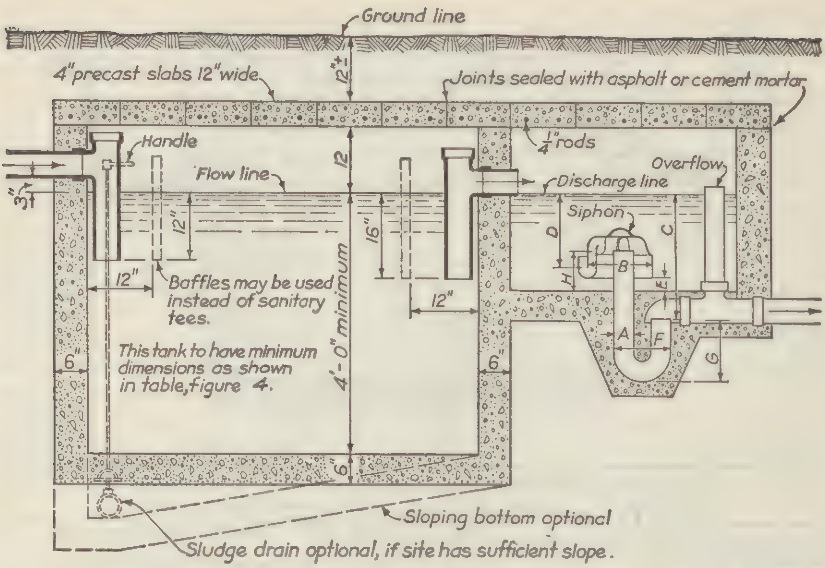
The siphon provides intermittent discharge of effluent, which allows time for the disposal area to rest and aerate between discharges. This is more important where the discharge is nearly continuous than in small installations.

The frequency and volume of the discharge into the tile field are controlled by the sizes of the siphon and the dosage chamber. The dealer should be informed of the size of the tank and the number of persons in the household, in order that he may furnish the proper unit. A 3- or 4-inch siphon will be adequate for almost any farmhouse installation.

Construction

Most septic tanks are built of concrete cast in place, since in this way there is a minimum possibility of cracks developing. Concrete blocks, however (not cinder blocks), stone, brick, or structural tile are sometimes used. Prefabricated commercial tanks of concrete and various other materials also are available.

Masonry units should be laid in full beds of 1 : 3 cement mortar and the walls and floor plastered with at least a ½-inch coat of 1 : 2 mortar.



SIPHON			
Diameter of siphon	A - 3" or 4"	Clearance under bell	E - 2"
Diameter of bell	B - 10" or 12"	Distance across U-trap	F - 10" or 12"
Bottom of outlet to discharge line	C - 20½" to 25¾"	Bottom of outlet to bottom of U-trap	G - 12" or 13"
Drawing depth	D - 13" to 17"	Height above floor	H - 7¼" to 11¾"

DIMENSIONS OF DOSING CHAMBER			
Number of persons served	Depth below discharge line [1]	Width [2]	Length
4 or less	16¼" to 20¼"	3'-0"	6'-0"
6	"	3'-0"	7'-0"
8	"	3'-6"	7'-6"
10	"	3'-6"	8'-6"
12	"	4'-0"	8'-6"
14	"	4'-0"	9'-0"
16	"	4'-6"	10'-0"
[1] Depending upon depth C of siphon.		[2] Same as single chamber tank, fig. 4.	

Figure 5.—Typical design for a concrete septic tank with a dosing chamber and a siphon.

Cells of concrete blocks and tile must be filled with concrete. Masonry walls are generally 8 inches thick, and care must be taken to follow *inside* dimensions given for concrete tanks. Directions for laying structural tile, brick, and concrete blocks can be obtained from dealers or trade associations.

Commercial tanks are suitable if they embody the essential features given in this bulletin. Capacities should be as recommended in figure 4 for concrete tanks. Proper installation and periodic servicing also are essential. Tanks badly damaged in handling should not be used.

Rapid corrosion of steel tanks will result if the asphalt coating is impaired. Minor defects in precast masonry tanks may often be overcome by plastering the interior with cement mortar.

BUILDING A CONCRETE TANK[3]

A convenient method of assuring correct location of the tank is to build a frame as shown in figure 6. Care is necessary to aline it with the center line of the inlet and outlet and to level it so that the distance from the bottom of the 2 by 4's on the form to the lower edge of the inlet hole in the form will permit it to be set at the grade of the house sewer. This frame is used to support the form for the tank. To avoid caving the edges, drive the stakes supporting the frame before beginning the excavation. The lumber in the frame can be used later to make part of the tank baffles.

Figure 7 shows how an inside form can be built and hung in place. The inlet and outlet tees should be carefully set and tied in place before the concrete is poured. A single length of pipe should be joined to the tee, so that the two can be set in the form as one unit. In most cases

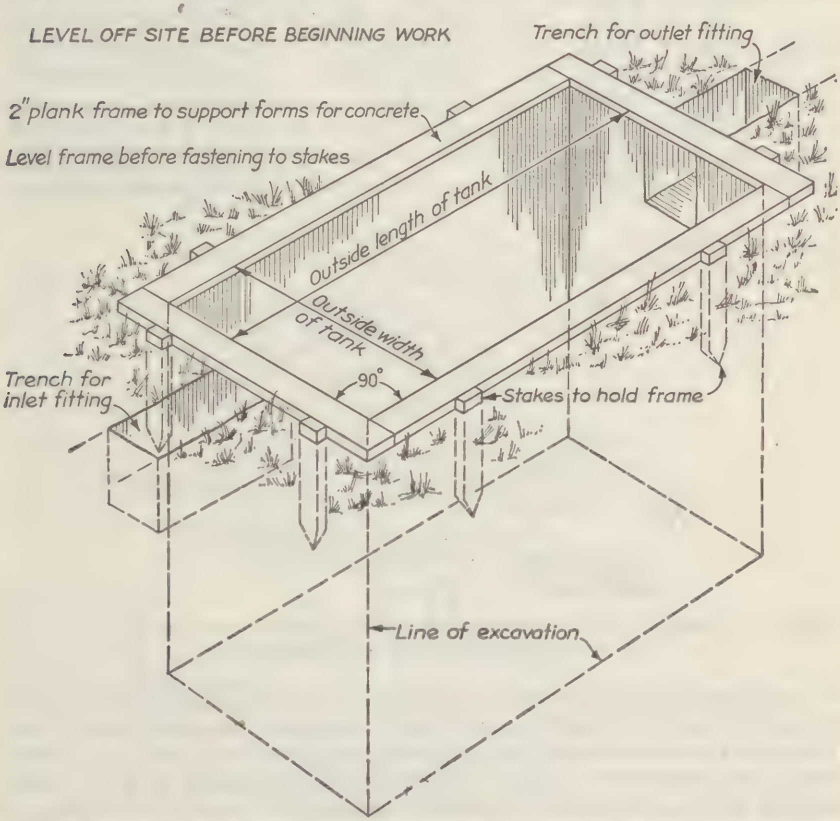


FIGURE 6.—Method of outlining a septic-tank excavation on the ground surface.

[3] For information on making and placing concrete, see Farmers' Bulletin 1772, Use of Concrete on the Farm.

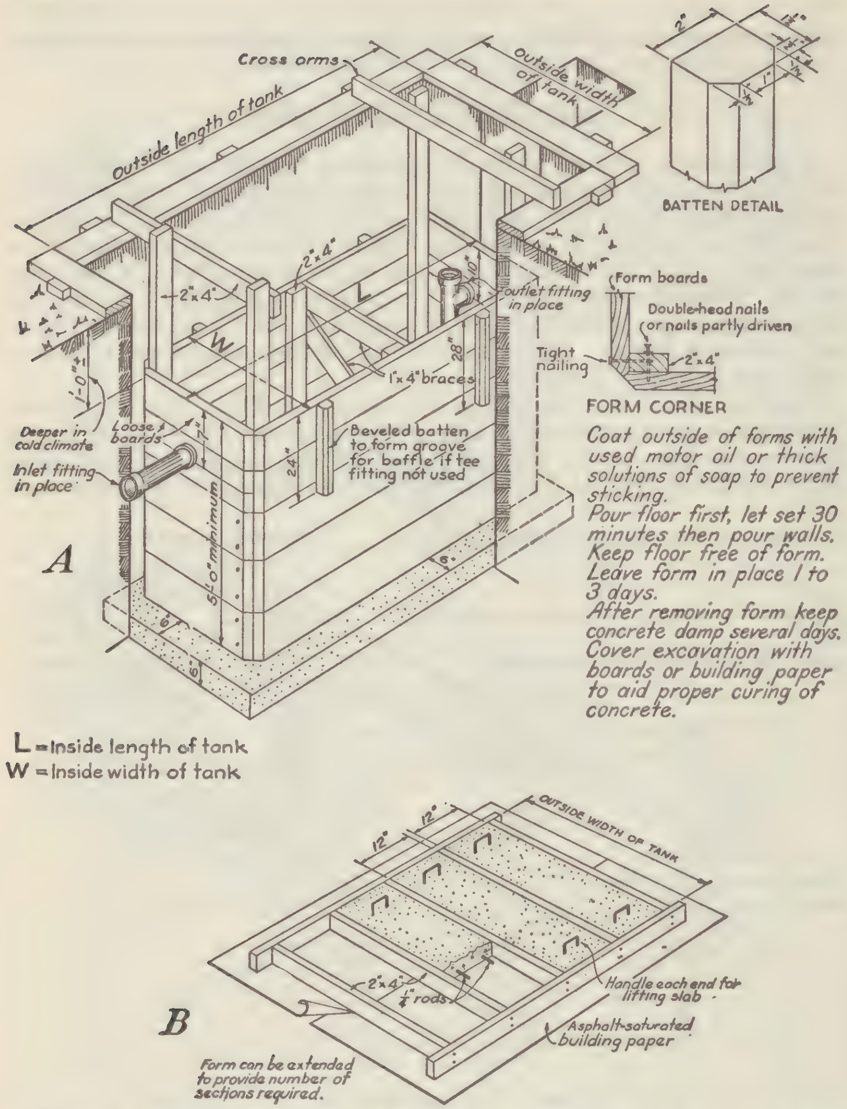


FIGURE 7.—Inside form hung in place for single-chamber septic tank, also a form for casting concrete-slab cover in sections.

the earth walls of the excavations will serve as the outside forms unless the soil is sandy or gravelly and the excavation is deeper than 5 feet. If outside forms are used, space must also be provided for them. Forms should be constructed before the excavation is made and the tank built as soon as practical, to avoid warping of forms and caving of earth walls.

County agricultural agents, local health departments, building-material dealers, and other agencies often have forms that may be borrowed or rented.

THE EFFLUENT SEWER

The effluent sewer should be constructed in similar manner and of the same materials as the house sewer and on a slope of ⅛ inch to 1 foot. This line, however, may be laid of terra-cotta pipe, as cast iron is not considered necessary except in unusual cases. This line should always terminate in a distribution box from which the tile lines of the disposal field lead away. For steep slopes the arrangement shown in figure 9 (p. 15) is practical. Joints must be of root-tight construction if the sewer is in the vicinity of trees or shrubs. The length of the sewer depends upon the distance from the tank to a safe site for the disposal field.

THE DISPOSAL FIELD

Correct installation of the disposal field is of great importance for proper functioning of the septic tank. Therefore, the width, depth, and spacing of the tile trenches must be carefully selected. Line of 4-inch, open-jointed, agricultural drain tile laid in shallow trenches are ordinarily used. Perforated fiber drain pipes also may be used and are obtainable in 4-foot lengths.

A distribution box with an inlet for the effluent sewer and an outlet for each individual run of disposal tile is the best means of dividing the flow. The outlet serving a large or double disposal field may be alternately opened and closed by means of a sewage switch that permits half the disposal field to work and rest alternately several weeks. A switch is especially helpful in tight soils but should not be provided

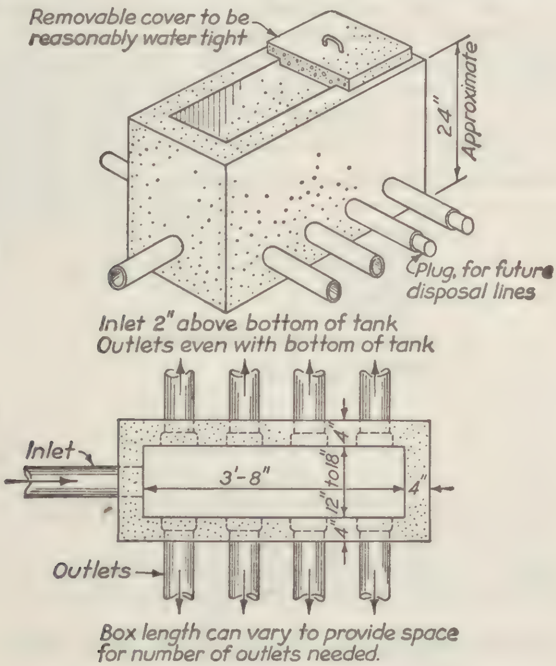


FIGURE 8.—Typical distribution box.

unless proper maintenance is assured, so that a portion of the disposal field will not be left to handle the entire load of the system for an indefinite period. There are many variations of boxes, but figure 8 shows a practical type.

Shallow Tile Lines

The disposal tile should not be more than 18 to 24 inches below the surface, and where the ground-water level rises to the bottom of the trench special underdrains, described on page 16, are necessary. Special provisions must also be made where tight soils are encountered. These methods are described in the section entitled "Disposal methods in tight or wet soils."

The table in figure 9, together with the information given in table 1, below, may be used for estimating the number of tiles needed in any particular soil type. If there is any doubt about this requirement, a percolation test should be made in the disposal field, as follows:

Dig a hole 1-foot square and to the depth at which the tile is to be laid. This depth in most instances will be about 24 inches and should not exceed 36 inches. Fill the hole with water to a depth of 6 inches and observe the time required for the water to seep away; divide by 6 to get the average time for the water to fall 1 inch. The test should be repeated at three or four different points in the disposal field and the average time noted for all tests used. The data in table 1 can then be used to determine the number of tiles needed. Where 1 hour is required for the water to fall 1 inch the soil is totally unsuitable, and another site should be selected. Soil conditions at the time of the test may vary from year-round average conditions, and this factor must be taken into account. If the soil appears exceptionally dry, greater depths of water may be used or the test repeated in the same hole. In no case should tests be made in filled or frozen ground. Where fissured rock formations are encountered, advice should be sought from sanitation specialists.

TABLE 1.—*Determining tile-disposal field requirements from percolation tests* [1]

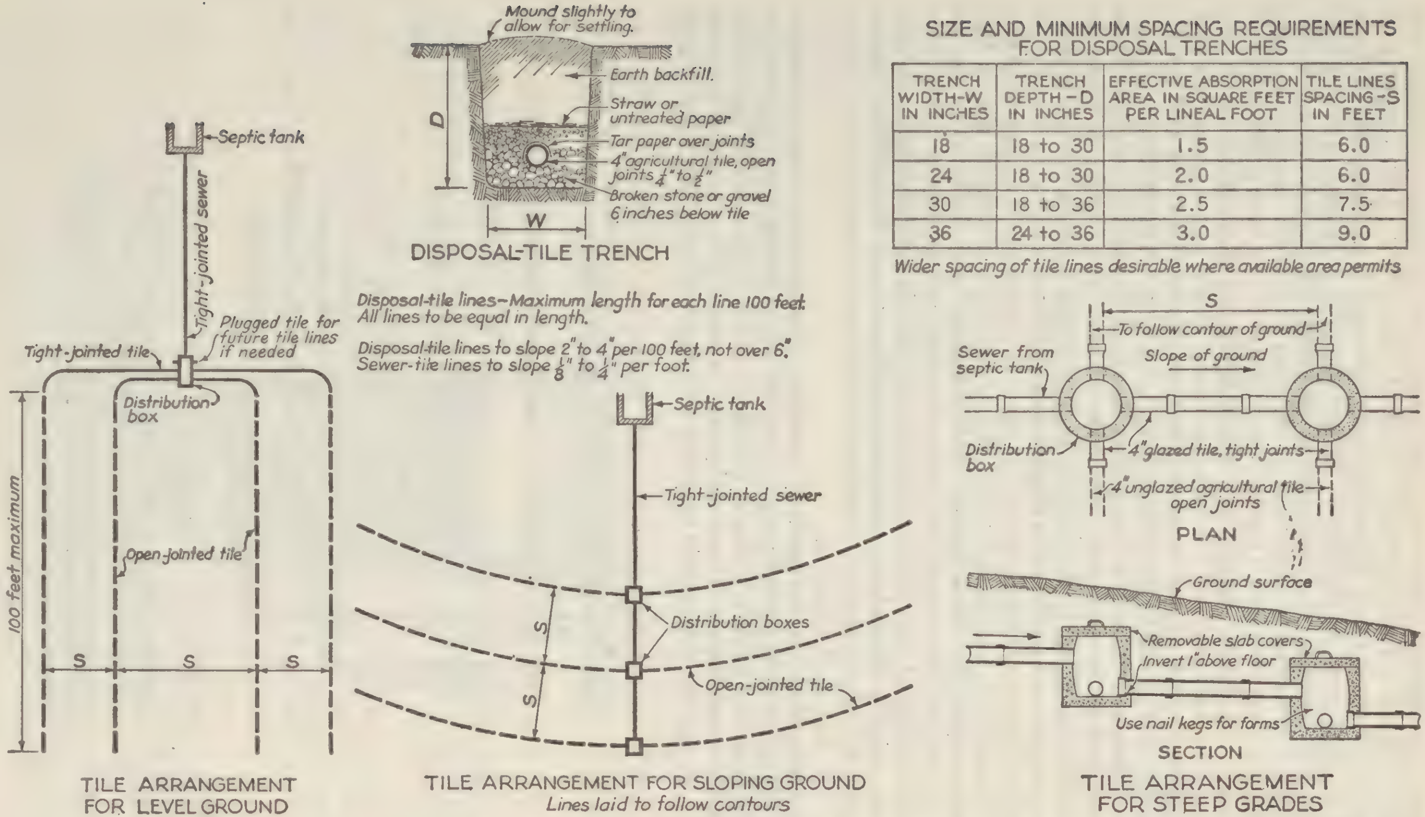
Minutes required for water to fall 1 inch	Effective absorption area required, per person, in bottom of disposal trenches	Minutes required for water to fall 1 inch	Effective absorption area required, per person, in bottom of disposal trenches
	Square feet		*Square feet*
2 or less	26	10	52
3	30	15	63
4	36	30	90
5	40	60 [2]	120

[1] A minimum of 150 square feet should be provided, equal to 100 feet of 18-inch trench.
[2] If more than 60 minutes, use special design with seepage pits or sand-filter trenches.

Figure 9 suggests methods of arranging the tiles in disposal fields under varying conditions and the length of tiles needed.

DISPOSAL METHODS IN TIGHT OR WET SOILS

If the soil is heavy clay or has tight formation, yet shows some porosity from percolation tests, the efficiency of the field may be in-



SIZE AND MINIMUM SPACING REQUIREMENTS FOR DISPOSAL TRENCHES

TRENCH WIDTH-W IN INCHES	TRENCH DEPTH-D IN INCHES	EFFECTIVE ABSORPTION AREA IN SQUARE FEET PER LINEAL FOOT	TILE LINES SPACING-S IN FEET
18	18 to 30	1.5	6.0
24	18 to 30	2.0	6.0
30	18 to 36	2.5	7.5
36	24 to 36	3.0	9.0

Wider spacing of tile lines desirable where available area permits

FIGURE 9.—Arrangements for tile-disposal fields, method of laying tile, and length of tiles needed.

creased by placing below the tile lines 12 to 15 inches of additional filter material (washed gravel, crushed stone, slag, clean cinders, or clean bank-run gravel ¾ to 2½ inches in size). When the surface soil is tight and is underlain by porous soil, sufficient drainage is sometimes obtained for the smaller installations by omitting the tile field and providing a dry well at the end of the effluent sewer, provided the water table will not be contaminated. Larger systems under such soil conditions should have a tile field, and absorption can be increased by boring 6- or 8-inch holes down to the porous stratum and filling them with gravel or sand; the holes should be 4 to 6 feet apart. Another and perhaps the best practice is to excavate the tile trenches 4 to 6 feet and install a lower tile line, as shown in figure 10. This latter method is especially desirable if the upper tight stratum is especially thick, or if there is no porous lower stratum, or if in irrigated regions and where the disposal field is limited in area.

Where the underdrain tile is not used, the absorption capacity of the field can be increased by providing a rock-filled trench across the lower end of the tiles for the full width of the field. The depth should be not less than 5 feet and the width not less than 3 feet.

On account of the beneficial action of bacteria in the upper soil layers it is highly desirable to confine the effluent near the surface rather than to use underdrains. Purification becomes slower and less effective, the deeper the drains.

In situations where the soil contains considerable moisture or is even saturated, the field may be improved by partially encircling it with a tile line laid to serve as a drain. Such a line should be on the high side and have surface outlets for removing the water from the soil. It should not be laid so close to a disposal tile line that it will

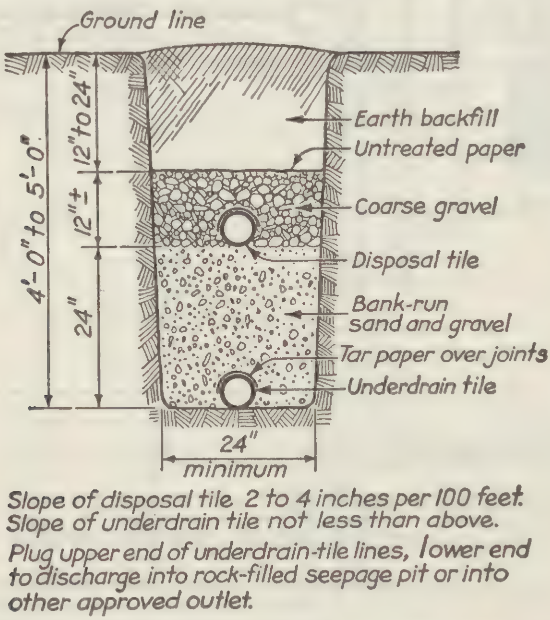


FIGURE 10.—Filter trench with underdrains.

drain the sewage effluent from the disposal field onto the surface of the ground.

When the tile field is underlain by stratified rock or where underdrainage is necessary, advice should be sought from the public health authorities, as regulations in some States may not permit the use of certain methods.

CARE AND MAINTENANCE OF SEPTIC TANKS

A septic tank when first used does not need starters, such as yeast, to promote bacterial action. A good septic tank normally requires no maintenance other than a yearly inspection and an occasional cleaning. Frequency of cleaning depends on the capacity of the tank and the quantity and composition of the sewage. Tanks of the size recommended in this bulletin may require cleaning at intervals of 3 to 5 years.

The tank should be cleaned when 18 to 20 inches of sludge and scum has accumulated. If a drain has not been provided, sludge may be removed by bailing or by pumping with a sludge or bilge pump. It is not necessary to remove the entire liquid contents. Burial in a shallow pit or trench with at least 18 to 24 inches of earth cover at a point remote from water sources is the most practical method for disposing of these wastes.

A septic tank is intended to handle sewage only. Coffee grounds and ground garbage may be included if there is an ample supply of water for flushing and the tank is cleaned more frequently than would otherwise be done. The size of the tank should be increased at least 25 percent if these materials are included in the sewage.

Do not use matches or an open flame to inspect a septic tank, as the gasses produced by decomposing sewage may explode and cause serious injury.

EFFECT OF DRAIN SOLVENTS AND OTHER MATERIALS

Soap, drain solvents, and other mild cleaning or disinfecting solutions used for normal household purposes cause no trouble in the tank. Constant use in large quantities, however, and disinfected wastes from the sickroom may prove harmful.

Wastes from milk rooms, strong chemicals used in sterilizing equipment or in photographic work, and the wastes from filters or water softeners not only reduce bacterial action but also cause abnormally rapid accumulations of sludge and clogging of the tile lines.

PROTECTION AGAINST FREEZING

Septic-tank systems seldom freeze when in constant use. Warm water and the decomposition of the sewage usually maintain above-freezing temperatures. In cold regions there is trouble from freezing if various parts of the system are not covered adequately. If the system is to be out of service for a period of time or if exposure is severe, it may be advisable to mound over the poorly protected parts of the system with earth, hay, straw, brush, leaves, manure, snow, or the like.

In cold regions it is not advisable to install the entire system below frost depth, as this will remove the effluent from the action of the aerobic bacteria in the upper layers of the soil and make the system generally less accessible.

New systems put into operation during very cold weather may freeze unless large quantities of hot water are discharged during the first few weeks.

SEPTIC-TANK TROUBLES

In sewage disposal, clogging of the disposal field is the most common trouble. This may be caused (1) by a tank too small for the volume of sewage, (2) by failure to clean the tank regularly, (3) by interior arrangement that does not provide slow flow through the tank or that allows scum or sludge to pass out with the effluent, or (4) by a disposal field that is too small or is incorrectly built.

The remedy for a clogged disposal field is to dig up and clean the tiles and re-lay them 3 or 4 feet to one side or the other of their former position. Sometimes a tile line can be cleaned by opening up the line at each end and flushing it thoroughly with a hose. With this method provision must be made to drain off and safely dispose of the water used for flushing.

Tile lines laid with improper slope allow the effluent to collect in a limited area and saturate the soil, causing odors. Bacteria cannot work in such areas, where the soil becomes sour, or "sewage-sick." These lines must be relaid on the correct slope. Odors or a water-logged soil may also indicate that the disposal field is too small.

House sewers frequently clog. This is due, in most cases, to roots and less frequently to trash, garbage, or other foreign materials discharged with the sewage. Greases in the sewer may cause trouble, especially when the slope is insufficient to give the sewage a cleansing velocity. Drain solvents will sometimes remove the obstruction, but more often it is necessary to clean the sewer by rodding. In some cases it may be necessary to dig up the line to reach the obstruction or, at least, to open the line so that it can be rodded from two directions. When it has been cleaned, a manhole could be built for use in case of future trouble. If stoppage is due to roots it may be necessary to re-lay the sewer with root-tight joints, or to move either the sewer or the vegetation so that roots cannot reach the line.

GREASE TRAPS

Grease traps (fig. 11) are not recommended for the average farm, because they clog easily and require frequent cleaning, but they are desirable for boarding houses and tourist camps where large quantities of grease are produced. The septic tank if of proper design and size will take care of the normal grease from most farm kitchens.

The traps must be several times larger than the quantity of greasy water discharged into them at any one time, in order to allow the greases to rise, but they should not be of less than 30 gallons' capacity.

The trap is best located in an accessible place in the basement or under the house close to the source of grease and safe from frost. Outdoor locations at shallow depths require a covering for insulation against freezing. Grease traps should be connected to the kitchen

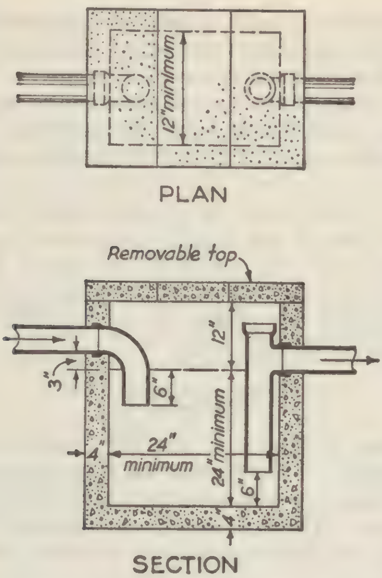


FIGURE 11.—Typical grease trap.

sink only and not to laundry, shower, or water-closet wastes. They must be cleaned periodically for satisfactory operation, and the outlet should be properly trapped.

DISPOSAL OF DRAINAGE FROM FIXTURES OTHER THAN TOILETS

When the farmhouse does not have an indoor toilet but does have a kitchen sink or other similar fixtures, the drainage can be disposed of as shown in figure 12. Even where septic tanks have been installed,

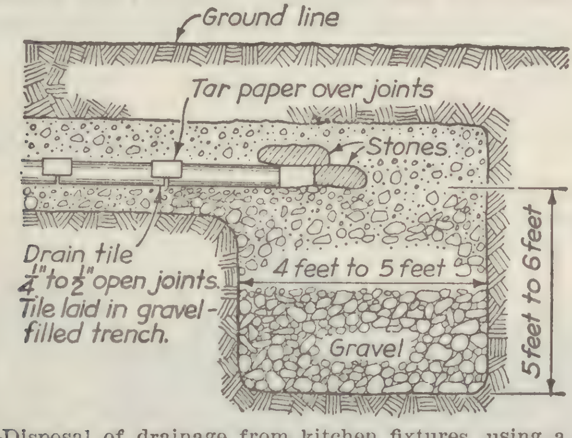


FIGURE 12.—Disposal of drainage from kitchen fixtures, using a line of terra cotta or fiber drain tile surrounded with gravel. One or two rock-filled pits at the end of the line increase the absorption area and are desirable where there are several fixtures or the soil is nonporous. The pits may be lined with boards or masonry laid without mortar and provided with a tight cover.

it is sometimes advisable to have a second disposal field for other fixtures than the toilet, to avoid overloading the tank, especially where large quantities of laundry water are discharged at one time.

These wastes are not likely to create serious health hazards, but they become nuisances if discharged promiscuously on the ground surface. Such drainage should never be permitted on the watershed of a spring.

Coarse sand and gravel, 12 to 18 inches deep, may be placed on the bottom of the pit, to strain out small particles of solids, which might clog the pores of the soil. If, after a few years, the sand or gravel becomes clogged with solids, it should be replaced with clean materials.

If excessive quantities of grease are permitted to enter the sink drain, a grease trap may be advisable.

CESSPOOLS

Cesspools are cheap in first cost but high in maintenance costs and often become nuisances. They should be located at least 150 feet from wells, 15 feet from seepage pits and property lines, and 20 feet from dwelling foundations. They should never be used in the vicinity of shallow wells and, in any case, only where permitted by State regulations.

The cesspool depends for its action upon seepage into the surrounding soil and consequently is particularly unsatisfactory in tight clay soils. In more open sand and gravel soils the seepage is reduced as the pores of the soil become clogged with particles of solids, until it stops entirely, and overflowing occurs. Emptying and then cleaning the walls and floor of a cesspool do not fully open up the clogged soil pores, and overflowing can be expected to occur soon again.

Solids in cesspools must be removed from time to time by bailing or pumping and should then be buried 18 to 24 inches deep in a trench where the water supply will not be endangered. Caustic potash (lye) will to some extent liquefy solids in a cesspool. This treatment does not eliminate the necessity of removing the contents when periodic inspection shows that the cesspool is nearly full. Caustic potash converts the greases into soft soap, whereas caustic soda forms a hard

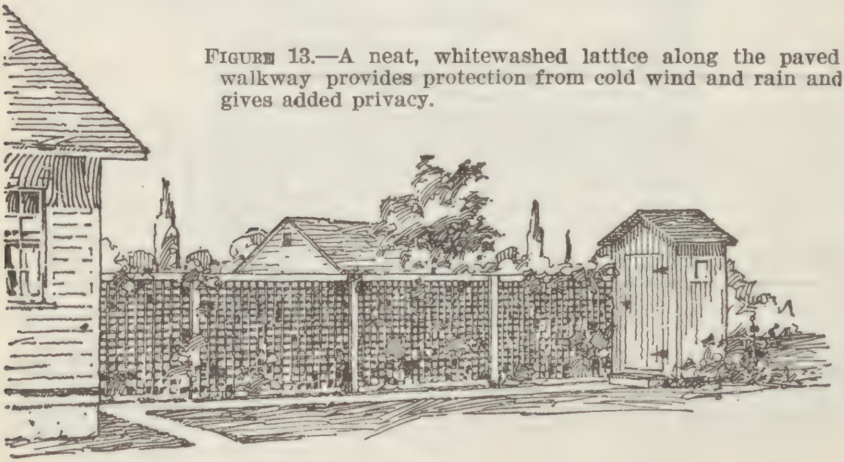


FIGURE 13.—A neat, whitewashed lattice along the paved walkway provides protection from cold wind and rain and gives added privacy.

soap that does not readily dissolve. The chemical treatment is not effective in liquefying solids in the pores of the soil surrounding the cesspool.

When clogging continues and cannot be corrected, in most cases the best solution to the problem would be to abandon the cesspool and install a septic-tank system with tile disposal field. The cesspool should be completely filled with stones, earth, or other solid materials to avoid possible cave-ins.[4]

PRIVIES

A privy when safely located and properly built and maintained is satisfactory for its purpose on the farm. Privies should be built 50 to 150 feet from the farmhouse, preferably on the opposite side of the house from prevailing winds, and at least 50 feet from the well. A site downhill from the well is generally safest. In some cases, however, the ground water may flow in a direction opposite to the slope of the surface, in which case the privy should be built on the other side of the well. Direction of flow may sometimes be learned from soil surveys, well-driller's data, or other similar sources. A distance of at least 6 feet from fences or other buildings allows for proper mounding of the privy and keeps it away from roof drainage from adjacent buildings.

Good, tight construction with screened ventilators keeps insects and birds from entering, prevents rapid deterioration of the building, and provides greater comfort for the user.

Certain features, while not essential to sanitation and satisfactory service, add to personal convenience. A paved walkway, well protected from cold winds and rain, is desirable. A neat, whitewashed lattice, as shown in figure 13, an arbor covered with vines, or a hedge screen adds to privacy.

The earth-pit privy is the simplest to build and the one most widely used. It is not generally recommended in localities where underground rock has crevices.

For a sanitary type of privy with reinforced concrete[5] floor, riser, and supporting sills see figure 14. Because privy units are commonly used as urinals, the use of impervious materials for risers and floors facilitates cleanliness. In the colder climates, wood treated with a preservative is durable and reduces the problem of moisture condensation. Therefore, wood could be used if approved by the State department of health.

When it is considered impracticable to build the slab and riser of concrete, these parts may be of wood, as shown in figure 15. The building itself may be as shown in either illustration. A wood structure is easy to move to a new location.

A pit with a minimum capacity of 50 cubic feet[6] will usually serve five people over a period of 5 to 10 years. The privy should be moved when the pit is filled to within 18 or 20 inches of the top

[4] See The Septic Tank, p. 8.

[5] For information on making concrete see Farmers' Bulletin 1772, Use of Concrete on the Farm.

[6] Recommended by the Committee on Promotion of Rural Sanitation, Public Health Engineering Section of the American Public Health Association, 1932.

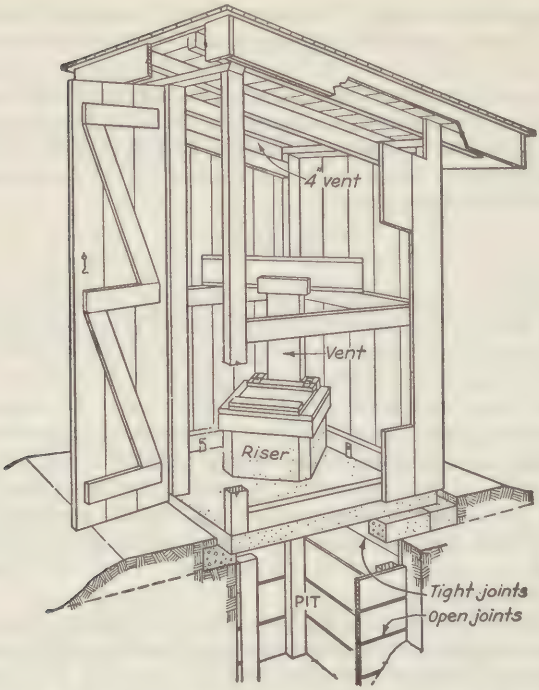


FIGURE 14.—Sanitary type of privy. Detailed plans and a bill of materials for this design can be had from the United States Public Health Service, Washington 25, D. C.

and a strong disinfectant spread in the old pit before covering it with earth.

It is important to have the earth-pit privy more than 50 feet from the well even where the water table is not near the surface. The ground water should flow from the well toward the privy, and it is important that this direction of flow be determined in advance.

Wood is most commonly employed for the main part of the building. The ground outside should be sloped as shown, to shed water away from the building, and the roof should extend beyond the walls to shed water away from the pit.

CARE AND MAINTENANCE

All privies require periodic attention. Seats and covers should be washed weekly with soap and water or with disinfectants, such as cresol, pine oil, and hypochlorite or chloride of lime. These have deodorant properties and are available at most grocery or drug stores. Druggists generally carry a more refined product and consequently the price is higher.

During the fly season fly and mosquito eggs will be destroyed by pouring half a pint of crude oil, crankcase oil, fuel oil, kerosene, or borax solution (1 pound powdered borax dissolved in about 10 gallons of water) over the contents of the pit about once a week.

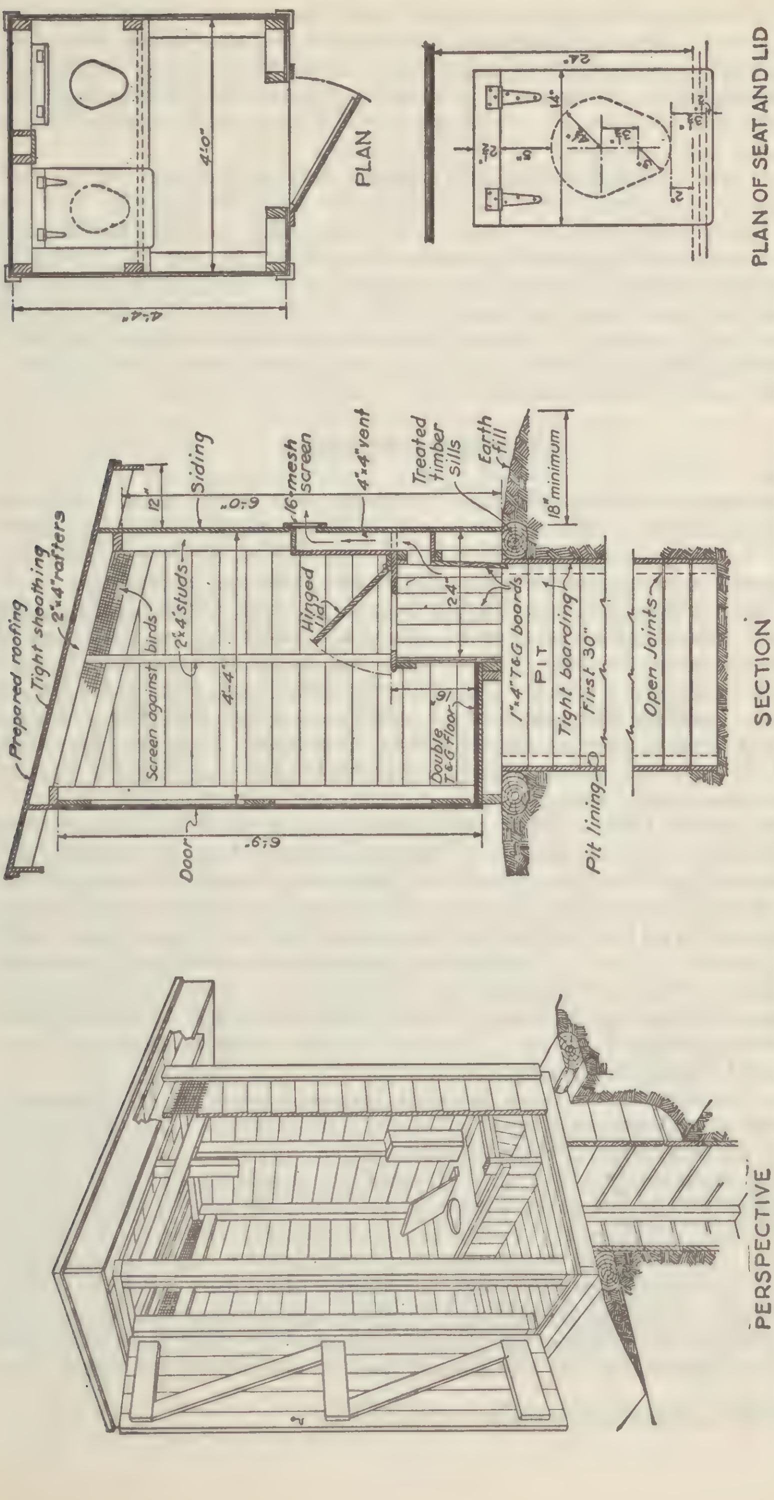


FIGURE 15.—Pit privy of all-wood construction. The sills and riser of this type should either be treated or made of cypress, redwood, cedar, locust, fir, or other decay-resistant wood.

Odors from privy pits and vaults can be reduced by covering the contents with dry earth, ashes, manure, or sawdust. These materials fill up the pit rather quickly, but can be used where other deodorants are not available. Sometimes two cakes of yeast dissolved in 2 gallons of water are effective in reducing odors. Commercial deodorants are available from suppliers of disinfectants.

If a person in the family has typhoid fever or is a carrier of that disease or has dysentery, it is advisable to disinfect the excreta. Fire, live steam, boiling water, and such chemicals as caustic soda (sodium hydroxide), caustic potash (potassium hydroxide), or hypochlorite or chloride of lime may be used. The heat generated by the slacking of quicklime is also effective. Best results are obtained if the infected material is treated prior to depositing it in the privy. Further advice may be obtained from physicians, local health officers, or State health departments.

CHEMICAL CLOSETS

In general, chemical closets should be used only where there are elderly or infirm people unable to get outdoors, particularly in wintertime. In some localities their use is forbidden by law because of improper maintenance. Strict adherence to the manufacturer's directions for making the installation is necessary to obtain satisfactory service. The chief advantage of chemical closets is that they may be within or adjoining the house and used without regard to soil or ground-water conditions. The caustic chemicals required, if used properly, reduce the quantity of solid matter by liquefying action, disinfect and deodorize the contents, and lessen danger from flies. Disadvantages are the cost of the chemicals and necessity for careful and constant maintenance.

The chemical-tank closet is generally recommended rather than the dry-type chemical closet. Three variations of tanks are available commercially. One type contains a clean-out opening in the top of the tank, through which the contents are removed by pumping or bailing. The second type has, in addition to a clean-out opening, a drain valve at the bottom, which is operated by a handle extending to a clean-out opening, so that gravity drainage of the tank is possible. The third type is self-draining; as the excreta are added an equal volume of liquid is spilled out the overflow. The solid matter must be removed manually or through the sludge drain.

The last-mentioned type requires frequent addition of chemicals, and the others are recharged after each emptying. The presence of odor is an indication of insufficient chemical or of the need for emptying and recharging. The same precautions apply to selecting an area for disposing of the tank wastes as to disposing of the materials removed from cesspools.[7] Since the contents of chemical closets are caustic, they may kill vegetation with which they come in contact.

The dry-type chemical closet is cheap, simple, and easy to install but requires frequent emptying. Pine tar and coal tar will accomplish only partial disinfection and deodorization, but caustic disinfectants produce liquefication in addition if used in sufficient quantities. The

[7] For disposal methods in tight soils, see p. 16.

caustic chemicals may cause burns if the receptacle is too full or if spilled where they come in contact with the body.

This form of closet is more of an expedient than a permanent installation, and daily care is necessary to prevent the development of insanitary conditions.

DISPOSAL OF GARBAGE AND TRASH

Domestic garbage and trash on farms can be divided into four classes—(1) waste of plant or animal origin suitable for animal feed, (2) unpalatable plant or animal waste, (3) combustible trash, and (4) noncombustible material. The disposal of these wastes is simplified if the four classes are kept separate.

Trash to be burned should be kept dry. Coffee grounds, tea leaves, citrus rinds, fish heads, entrails, eggshells, and similar material are most readily handled if drained and put in paper sacks.

Cans should be placed where they will not collect water and become breeding places for mosquitoes. Cans will corrode faster if heated sufficiently to burn off all grease. When the trash accumulates it should be hauled to some out-of-the-way place, such as a gully, or buried.

Neat-appearing garbage containers are desirable for kitchen use and should be small enough to require daily emptying. Large containers may be placed within easy reach outside the house and screened with a lattice fence or shrubbery. Substantial containers of rust-resistant metal will not quickly become an eyesore and a nuisance. Tight covers should be used to keep out prowling animals and to eliminate the habit of tossing wastes from the back door. Open or wooden containers are not recommended.

A good way to protect the garbage pail is to place it in a small pit that has a manhole frame and a lid that can be raised by foot pedal. A gravel bottom in the pit will assist in draining water away.

Outdoor receptacles, if emptied and cleaned once a week, generally do not become foul. Grease, coffee grounds, and other similar materials that adhere to the sides of containers can be removed by scraping with a little sand prior to scalding.

Electrically operated units grind garbage and bones and discharge the material through the kitchen-sink drain. They will not handle tin cans, glass, and the like. They may be used on farms if the septic tank is larger than normal and if sufficient water is available for flushing the drain to prevent clogging.

Garbage to be fed to animals should be preserved as carefully as is human food. To prevent the spread of trichinosis and other diseases, it should be cooked before it is fed to hogs. Garbage left uneaten by the animals should be disposed of by one of the methods described above.

Incineration is the most sanitary method of disposing of farm wastes. Garbage, however, is not easily burned. Figure 16 shows a type of incinerator [8] suitable for farm homes. Details of construction for a brick incinerator are given in figure 17. Brick, stone, concrete,

[8] Blueprints of this design may be obtained from the extension agricultural engineers at most of the State colleges.

or other fire-resistant material may be used. Commercial incinerators, some of which are designed to be built into the house, also are available, although these cost considerably more than the home-made type shown.

A limited quantity of refuse may be burned in a kitchen range or a furnace, but it may cause accumulations of grease in the flue and require frequent cleaning to prevent fire.

Next to burning, burial is the most desirable method of waste disposal. Waste material may be deposited in a trench 3 or 4 feet wide, 7 or 8 feet long, and 4 or 5 feet deep and covered with earth when filled to within 18 inches of the top. If there is no fire hazard, the contents of the trench may be burned.

Garbage may be included in a compost heap with leaves, peat, manure, and similar materials. The compost pile should be in an inconspicuous place, built up to the desired height with materials that will rot, and then covered with 2 or 3 inches of earth. The top should be level and the sides steep sloping. It is necessary that the material being composted be kept moist; otherwise it will not rot. Frequently commercial fertilizer is added to increase the fertilizing value of the compost.

Ashes and clinkers removed from furnaces should be placed in metal containers to eliminate fire hazard. Wood ashes may be spread on the lawn or garden, as they have some fertilizing value.

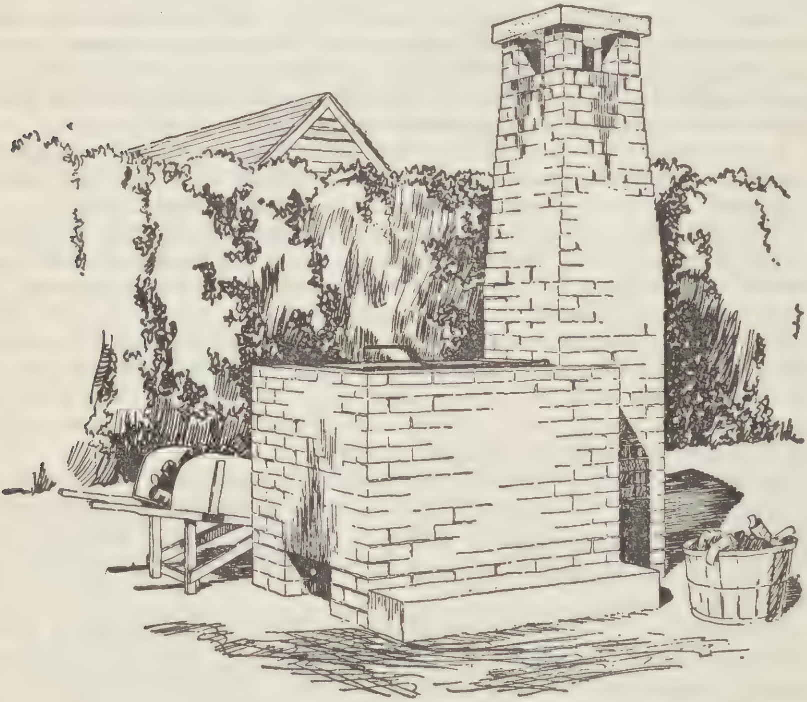


FIGURE 16.—A satisfactory incinerator for household use.

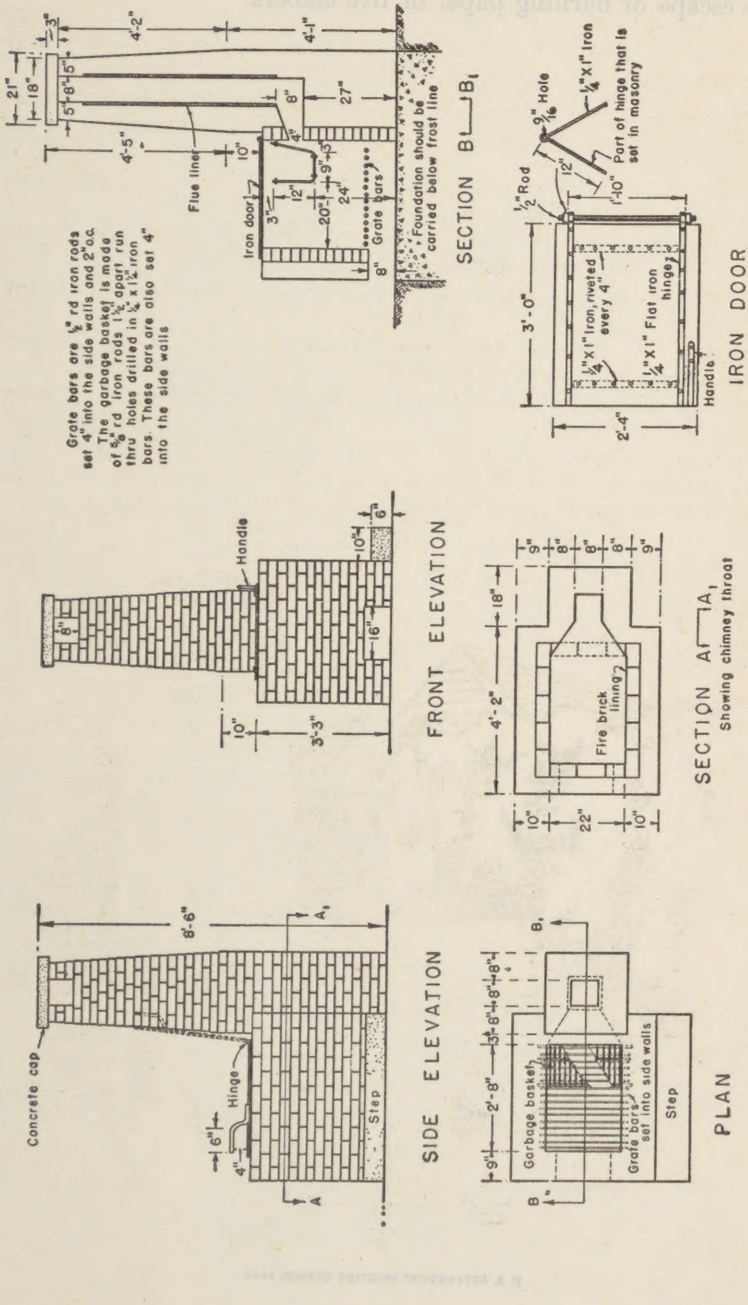


FIGURE 17.—Details of construction of the household incinerator pictured in figure 16.

Trash burners of various designs suitable for burning small quantities of paper and rags are available or may be improvised. The main requirements are provision for adequate draft and for preventing the escape of burning paper or live embers.

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